EXHIBIT A

United States Patent [19]

Dyson

[11] **Patent Number: 4,643,748**

[45] **Date of Patent: Feb. 17, 1987**

[54] **CLEANING APPARATUS**

[75] Inventor: **James Dyson**, Bathford, England

[73] Assignee: **Notetry Limited**, Bristol, England

[21] Appl. No.: **832,370**

[22] Filed: **Feb. 24, 1986**

[51] **Int. Cl.**[4] **B01D 45/12**

[52] **U.S. Cl.** ..... **55/338**; 55/345; 55/392; 55/417; 55/429; 55/459 R

[58] **Field of Search** ..... 55/338, 345, 392, 417, 55/429, 459 R; 209/144, 211

[56] **References Cited**

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4,593,429	6/1986	Dyson	55/429

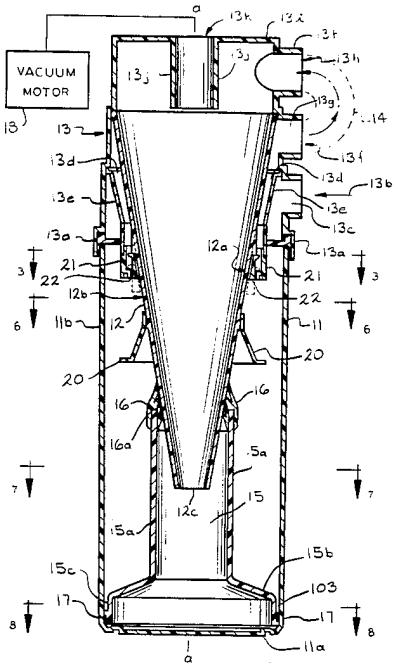
Primary Examiner—Bernard Nozick

Attorney, Agent, or Firm—Ian C. McLeod

[57] **ABSTRACT**

An improved cleaning apparatus **10** is described wherein a shroud **21** with a moveable collar **22** is provided on the outside surface **12***b* of a cyclone **12** in an air outlet **13***d* from a container **11** leading to the cyclone **12** to dislodge accumulated dirt in the air outlet when a fan **18** drawing air through the apparatus is stopped. The apparatus preferably has a disc **20** which prevents long strands, such as hair, in the dirt from clogging the air outlet **13***d* from the container **11.** The apparatus is preferably in the form of a vacuum cleaner.

18 Claims, 8 Drawing Figures



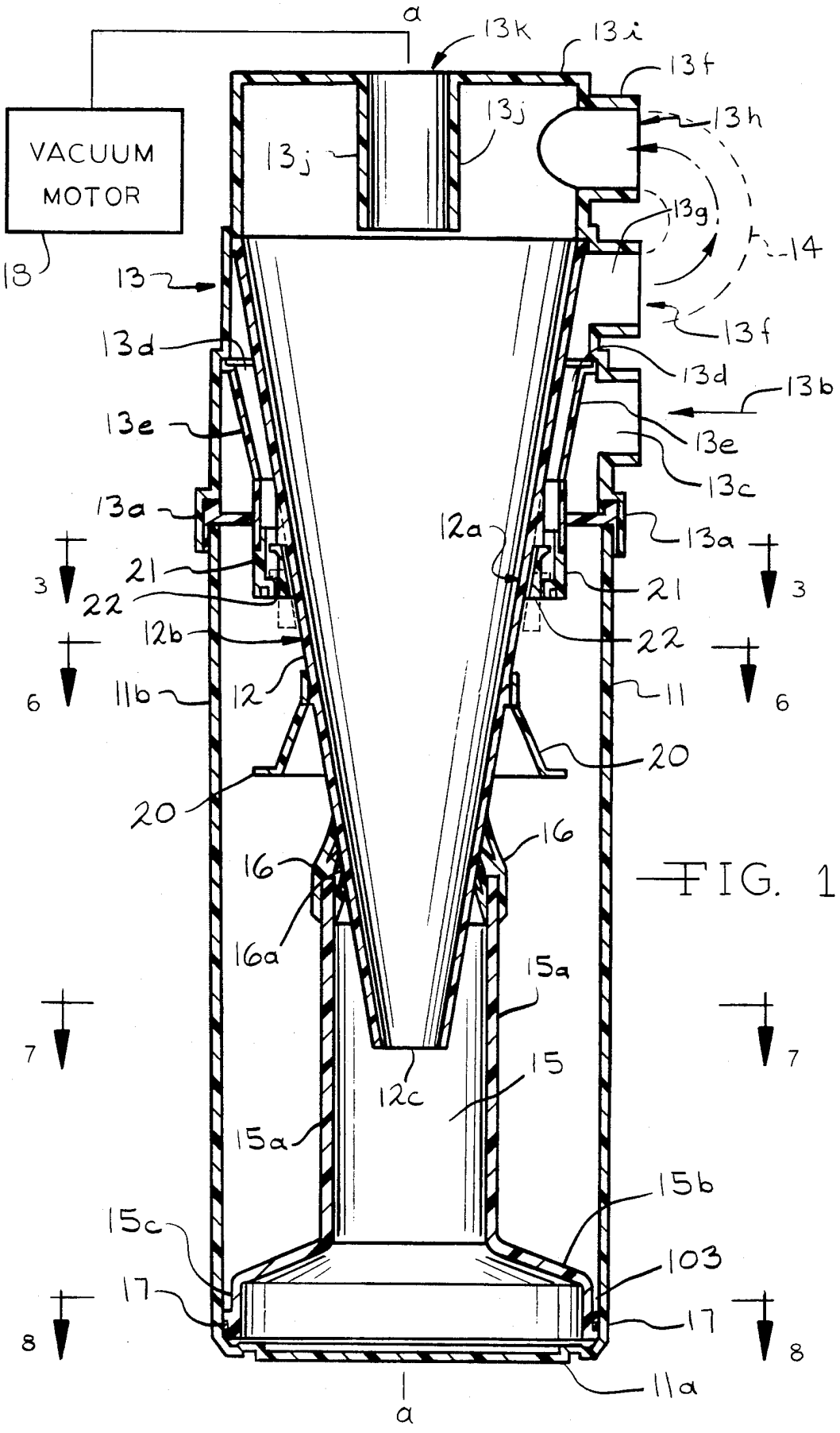

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FIG. 1

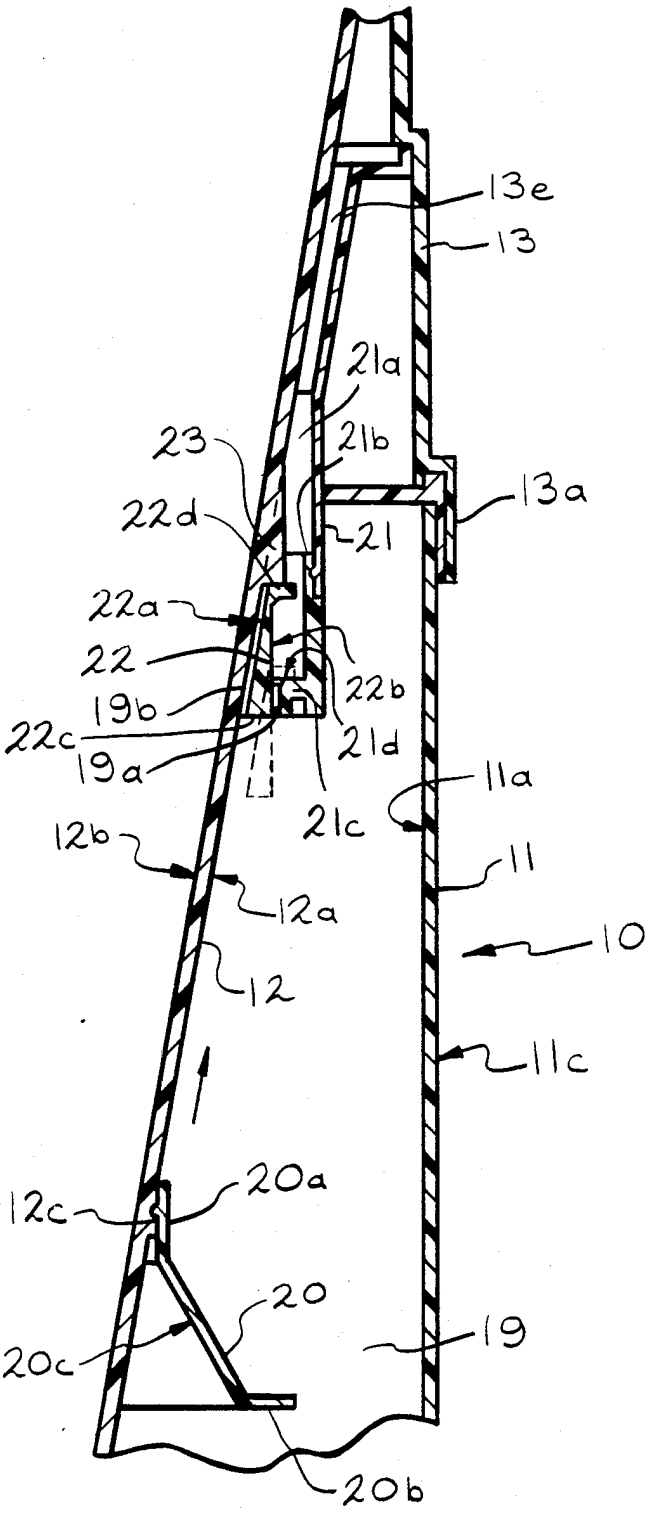
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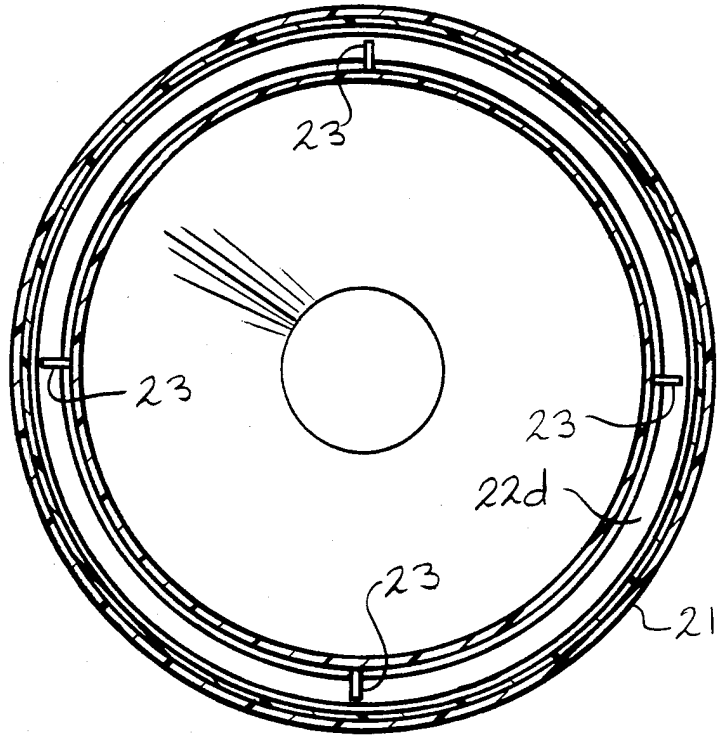
FIG. 2

FIG. 3



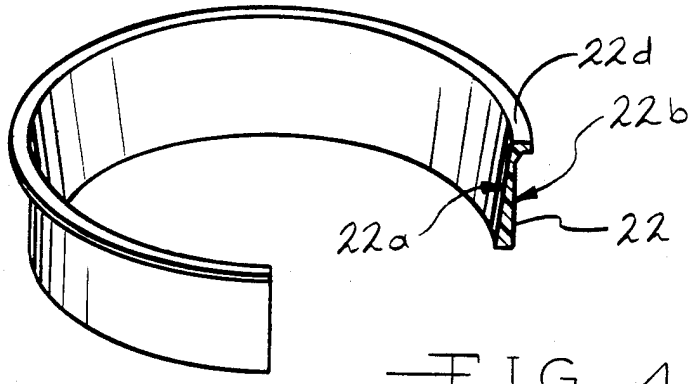


FIG. 4

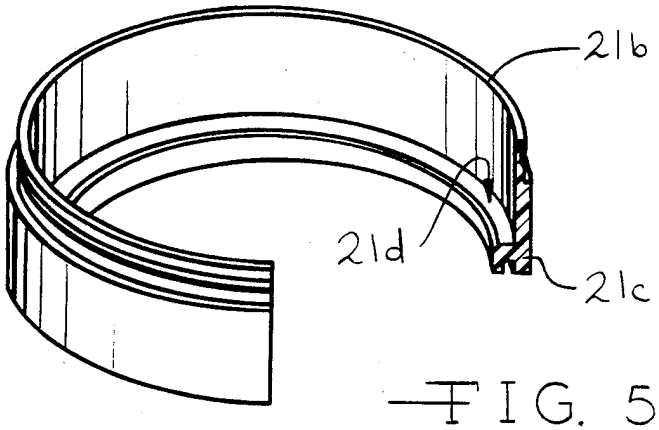


FIG. 5

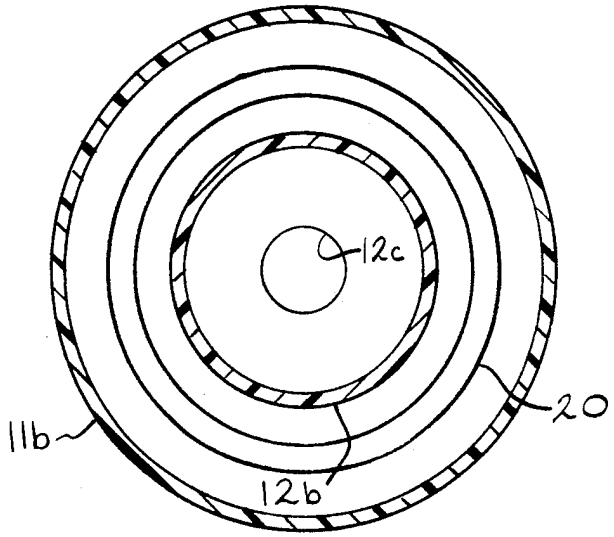
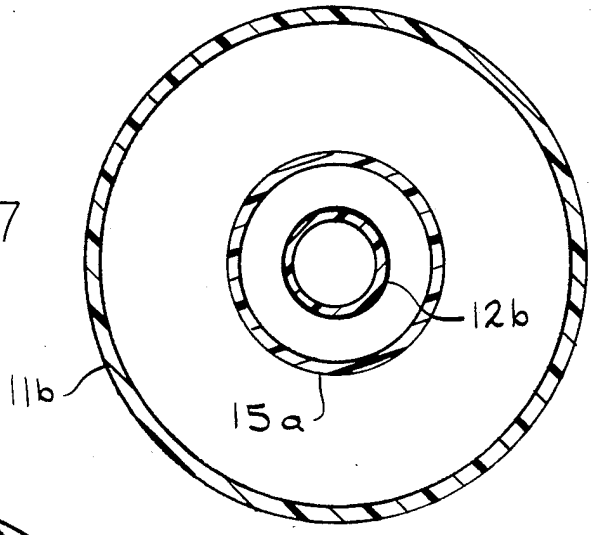


FIG. 6

FIG. 7



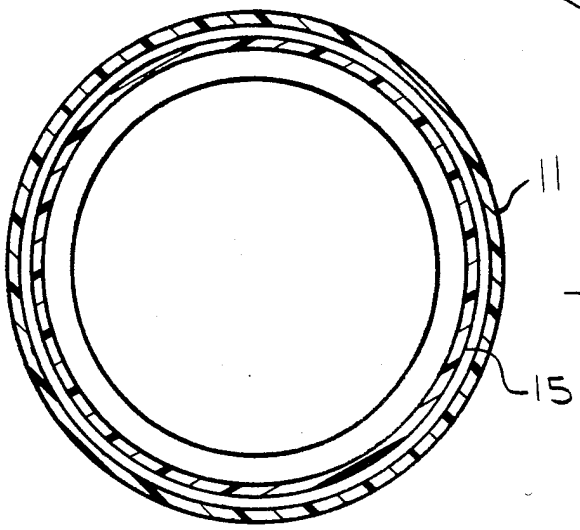


FIG. 8

CLEANING APPARATUS

BACKGROUND OF THE INVENTION

(1) Field of the Invention

The present invention relates to an improved vacuum cleaning apparatus. In one form the apparatus includes a movable collar which ejects dirt from an air outlet from an outer container leading to an inner cyclone. In another form the apparatus includes a disc mounted on an outside surface of the cyclone and spaced from the inner wall of the container which prevents long strands such as hair from entering the air outlet from the container to the inner cyclone. Preferably the collar and disc are used together.

(2) Prior Art

The basic cleaning apparatus with an outer cyclone or container and an inner cyclone is described in the inventor's Canadian Pat. No. 1,182,613 granted Feb. 19, 1985 and corresponding to U.S. application Ser. No. 640,758 filed Aug. 14, 1984. The inventor is unaware of any prior art describing inventions similar to the present invention. The problem with these dual cyclone devices is that dirt, particularly hair and larger dirt particles, tends to clog the air outlet from the container leading to the inner cyclone. Until the present invention, there has been no solution to the problem except to use a filter in the air outlet which defeats the purpose of a cyclonic cleaning apparatus. Filters reduce air flow through the apparatus as dirt accumulates and must be cleaned or replaced periodically.

OBJECTS

It is therefore an object of the present invention to provide an improved cleaning apparatus which reduces or eliminates the air outlet clogging problem in cyclonic cleaning apparatus. Further it is an object of the present invention to provide means for preventing the clogging of the air outlet which are simple and inexpensive to construct and avoid the need for a filter at the air outlet. These and other objects will become increasingly apparent by reference to the following description and the drawings.

IN THE DRAWINGS

FIG. **1** is a front cross-sectional view of the improved apparatus of the present invention particularly illustrating a movable collar **22** and a disc **20** intermediate the bottom of an outer container and the air outlet.

FIG. **2** is an enlarged cross-sectional view of the collar **22** and disc **20** shown in FIG. **1**.

FIG. **3** is a plan cross-sectional view along line **3—3** of FIG. **1** showing stops **23** for collar **22**.

FIG. **4** is an isometric view of the collar **22** shown in FIG. **1**.

FIG. **5** is an isometric view of the shroud **21** which holds the collar **22** on the air outlet.

FIGS. **6** to **8** are plan cross-sectional views along lines **6—6**, **7—7** and **8—8**, respectively, of FIG. **1** showing the circular cross-sections of various parts of the apparatus.

GENERAL DESCRIPTION

The present invention relates to a cleaning apparatus including an outer container comprising a bottom and a sidewall extending to and meeting the bottom, the sidewall having an interior surface, a dirty air inlet at an upper portion of the outer container spaced from the bottom which is oriented for supplying dirt laden air into the container tangentially to the interior surface of the outer container which has a circular cross-section and an air outlet from the container at the upper portion of the container; a circular cross-sectioned cyclone having a longitudinal axis and mounted inside the container, the cyclone comprising a cyclone air inlet at an upper end having a first diameter of the cyclone in air communication with the air outlet of the container, an interior dirt rotational surface of frusto-conical shape for receiving an air flow from the air inlet and for maintaining its velocity to a cone opening smaller in diameter than the diameter of the upper end of the cyclone, the air inlet being oriented for supplying air tangentially to the surface, an outer surface of frusto-conical shape, and a cyclone air outlet communicating with the interior of the cyclone adjacent the upper end of the cyclone; a dirt receiving and collecting chamber extending from the cone opening; and means for generating an air flow which passes sequentially through the dirty air inlet, the container, the cyclone air inlet, the cyclone, the receiving chamber and the cyclone air outlet, the air flow rotating around the frusto-conical interior surface of the cyclone and depositing the dirt in the receiving chamber the improvement which comprises: shroud means which provides an extension of the air outlet from the container mounted around the outer surface of the cyclone, the shroud means having a circular cross-section around the longitudinal axis of the cyclone and extending from the air outlet towards the bottom of the container; and collar means moveably mounted on the shroud means around the outer surface of the cyclone so as to be moveable parallel to the longitudinal axis of the cyclone into the shroud means when the air flow is generated and out of the shroud means when the air flow is stopped to thereby prevent dirt from being entrapped in the air outlet.

Further the present invention relates to a cleaning apparatus including an outer container comprising a bottom and a sidewall extending to and meeting the bottom, the sidewall having an interior surface, a dirty air inlet at an upper portion of the outer container spaced from the bottom which is oriented for supplying dirt laden air into the container tangentially to the interior surface of the outer container which has a circular cross-section and an air outlet from the container at the upper portion of the container; a circular cross-sectioned cyclone having a longitudinal axis and mounted inside the container, the cyclone comprising a cyclone air inlet at an upper end having a first diameter of the cyclone in air communication with the air outlet of the container, an interior dirt rotational surface of frusto-conical shape for receiving an air flow from the air inlet and for maintaining its velocity to a cone opening smaller in diameter than the diameter of the upper end of the cyclone, the air inlet being oriented for supplying air tangentially to the surface, an outer surface of frusto-conical shape, and a cyclone air outlet communicating with the interior of the cyclone adjacent the upper end of the cyclone; a dirt receiving and collecting chamber extending from the cone opening; and means for generating an air flow which passes sequentially through the dirty air inlet, the container, the cyclone air inlet, the cyclone, the receiving chamber and the cyclone air outlet, the air flow rotating round the frusto-conical interior surface of the cyclone and depositing the dirt in the receiving chamber the improvement which com-

prises: a disc means provided on the outside of the cyclone intermediate the receiving chamber and the air outlet of the container and around to the longitudinal axis of the cyclone with a space between the interior surface of the container and the disc means for passage of air wherein the disc means retards long strands in the dirt from clogging the air outlet and retains the strands in the container.

SPECIFIC DESCRIPTION

FIGS. **6** to **8** show a cleaning apparatus **10**, an outer cyclone or container **11** and an inner cyclone **12**. The cyclones **11** and **12** are relatively long and slender along longitudinal axis a-a. The outer cyclone **11** has a bottom **11***a* and a cylindrical inner surface **11***b*. The outer cyclone **11** is removable from an air flow directing head **13** where lips **13***a* engage the outside surface **11***c* of the outer cyclone **11**. The head **13** includes a dirty air inlet passage **13***b*, inlet port **13***c* and an air outlet **13***d* defined by a tapered portion **13***e* on head **13** leading to outlet passage **13***f* in outlet port **13***g*. In the cylindrical portion **13***i* of head **13** an outlet port **13***j* is provided for removal of clean air through passage **13***k*. As shown by the dotted lines in FIG. **1**, tube **14** connects the outlet port **13***g* to an inlet port **13***f* having a tangential entry passage **13***h* in cylindrical portion **13***i* of head **13**.

The inner cyclone **12** has a frusto-conical shape and inner wall **12***a* leading to a cone opening **12***c* and outer wall **12***b*. A portion of the cyclone **12** and cone opening **12***c* projects into a receiving and collecting chamber **15** for collecting dirt from the cyclone **12**. The outer wall **12***b* of the inner cyclone **12** engages a tapered ring seal **16** mounted on the receiving chamber **15**. The tapered seal **16** includes concentric rings **16***a* engaging outer wall **12***b* and is mounted on an elongate cylindrical portion **15***a* of the receiving chamber **15**. The receiving chamber **15** is preferably integrally joined with a frusto-conical or outwardly tapered portion **15***b* which is in turn integral with a short cylindrical portion **15***c*. An o-ring seal **17** provides an air seal between the receiving chamber **15** and the outer cyclone **11**. The outlet port **13***j* is connected with a fan unit **18**.

As can be particularly seen from FIGS. **1** and **2**, a disc **20** is positioned on the outside surface **12***b* of the cyclone **12**. The disc **20** includes a detent **20***a* (FIG. **2**) in smaller opening **20***b* which engages an attachment ring **12***c* on the cyclone **12**. The disc **20** includes a downwardly tapered wall **20***c* and an annular flange **20***d* extending towards the inside wall **11***a* of the container **11**. The disc **20** retards long strands, such as hair, from moving upwards into air outlet **13***d* through a shroud **21** attached to outlet **13***d*. The disc **20** can have any shape which is circular around the axis a-a and leaves an air passage **19**.

The shroud **21** attaches to the tapered portion **13***e* around the outside surface **12***a* of the cyclone **12**. The shroud **21** includes a removable portion **21***c* which allows the removal of a vertically moveable collar **22**. The collar **22** moves from a rest position in the shroud **21** without the fan **18** operating as shown by the dotted lines in FIG. **2** to an operating position as shown by the solid lines in FIG. **2**. The collar **22** engages stops (FIG. **3**) **23** in the operating mode with the fan **18** operating.

In its preferred form, the collar **22** has a right triangular cross-section including a hypotenuse **22***a* which gives the collar **22** a taper corresponding to that of the outer surface **12***b* of the cyclone **12**, a long side **22***b* which is parallel to the axis a-a and a short side **22***c* which connects the long side **22***b* and the hypotenuse **22***a*. The vertex of the hypotenuse **22***a* and long side **22***b* is provided with a rim **22***d* which engages a lip **21***d* of the shroud **21**. The angle between the hypotenuse **22***a* and the long side **22***b* is preferably between about 9 and 11 degrees.

The short side **22***c* of the collar **22** is blunted so that air flow created by fan **18** lifts the collar **22** and moves the collar **22** into the shroud **21**. Any similar configuration of the collar **22** which allows the collar **22** to move in the shroud **21** is satisfactory. Generally the collar has a smaller end inside the collar **22** and a larger end projecting from the collar **22** when there is no air flow. The larger end has a surface area which is in the air flow path to cause the collar **22** to move into the shroud **21** when air flow is generated.

In operation, the fan **18** is turned on and the collar **22** moves into the shroud **21**. Larger particles of dirt may lodge in the spaces **19***a* and **19***b* between the collar and the shroud **21**. When air flow is stopped by turning off the fan **18**, the collar moves towards the bottom **11***a* of the container **11** and any accumulated dirt falls back into the container **11**. In this manner only very fine dirt particles are carried over into the cyclone **12** and are deposited in the receiving chamber **15**.

The disc **20** retards the flow of long strands of dirt into the shroud **21**. The long strands are curled into a ball and thus remain in the container **11**.

The apparatus can be in the form of an upright vacuum cleaner as described in Canadian Pat. No. 1,182,613 and in the inventor's U.S. Pat. application Ser. No. 628,346, filed July 6, 1984 and Ser. No. 640,758 filed Aug. 14, 1984.

It is intended that the foregoing description only be illustrative of the present invention and the invention is limited only by the hereinafter appended claims.

I claim:

1. In a cleaning apparatus including an outer container comprising a bottom and a sidewall extending to and meeting the bottom, the sidewall having an interior surface, a dirty air inlet at an upper portion of the outer container spaced from the bottom which is oriented for supplying dirt laden air into the container tangentially to the interior surface of the outer container which has a circular cross-section and an air outlet from the container at the upper portion of the container; a circular cross-sectioned cyclone having a longitudinal axis and mounted inside the container, the cyclone comprising a cyclone air inlet at an upper end having a first diameter of the cyclone in air communication with the air outlet of the container, an interior dirt rotational surface of frusto-conical shape for receiving an air flow from the air inlet and for maintaining its velocity to a cone opening smaller in diameter than the diameter of the upper end of the cyclone, the air inlet being oriented for supplying air tangentially to the surface, an outer surface of frusto-conical shape, and a cyclone air outlet communicating with the interior of the cyclone adjacent the upper end of the cyclone; a dirt receiving and collecting chamber extending from the cone opening; and means for generating an air flow which passes sequentially through the dirty air inlet, the container, the cyclone air inlet, the cyclone, the receiving chamber and the cyclone air outlet, the air flow rotating around the frusto-conical interior surface of the cyclone and depositing the dirt in the receiving chamber the improvement which comprises:

(a) shroud means which provides an extension of the air outlet from the container mounted around the outer surface of the cyclone, the shroud means having a circular cross-section around the longitudinal axis of the cyclone and extending from the air outlet towards the bottom of the container; and

(b) collar means moveably mounted on the shroud means around the outer surface of the cyclone so as to be moveable parallel to the longitudinal axis of the cyclone into the shroud means when the air flow is generated and out of the shroud means when the air flow is stopped to thereby prevent dirt from being entrapped in the air outlet.

2. The apparatus of claim **1** wherein the collar means has a larger end projecting from the shroud means towards the bottom of the container with a rim on a smaller end opposite the larger end which rests on a lip of the shroud means when the air flow is stopped.

3. The apparatus of claim **2** wherein the collar means has a cross-section positioned along the longitudinal axis in the form of a right triangle with the hypotenuse adjacent to and parallel to the outer surface of the cyclone, a short side at the larger end of the collar means perpendicular to the longitudinal axis and a long side parallel to the longitudinal axis and wherein the rim is positioned on the collar means adjacent the intersection of the long side and the hypotenuse at the smaller end of the collar means.

4. The apparatus of claim **3** wherein the collar means has an angle of between about 9° and 11° between the long side and the hypotenuse.

5. The apparatus of claim **1** wherein a portion of the shroud means is removable so that the collar means can be separated from the shroud.

6. The apparatus of claim **1** wherein a stop means is provided on the outer surface cyclone to restrict the movement of the collar means into the shroud when the air flow is generated in the apparatus.

7. The apparatus of claim **6** wherein the stop means is engaged by the rim on the collar means.

8. The apparatus of claim **1** wherein a disc means is attached on the outside of the cyclone around the longitudinal axis and intermediate the shroud means and dirt receiving and collecting chamber with a space between the interior surface of the container and the disc means wherein the disc means retards long strands in the dirt from clogging the air outlet and retains the strands in the container.

9. The apparatus of claim **1** wherein the collar means has a larger end projecting from the shroud means towards the bottom of the container with a rim or a smaller end opposite the larger end which rests on a lip of the shroud means when the air flow is stopped and wherein a disc means is provided on the outside of the cyclone around the longitudinal axis and intermediate the shroud means and dirt receiving and collecting chamber with a space between the interior surface of the container and the disc means wherein the disc means retards long strands in the dirt from clogging the air outlet and retains the strands in the container.

10. The apparatus of claim **9** wherein the collar means has a cross-section positioned along the longitudinal axis in the form of a right triangle with the hypotenuse adjacent to and parallel to the outer surface of the cyclone, a short side at the larger end of the collar means perpendicular to the longitudinal axis and a long side parallel to the longitudinal axis and the rim is positioned on the collar means adjacent the intersection of the long side and the hypotenuse at the smaller end of the collar means which rests on the lip of the shroud means when the air flow is stopped.

11. The apparatus of claim **10** wherein the collar means has an angle of between about 9° and 11° between the long side and the hypotenuse.

12. The apparatus of claim **9** wherein a stop means is provided on the outer surface of the cyclone to restrict the movement of the collar means into the shroud means when the air flow is generated in the apparatus.

13. The apparatus of claim **12** wherein the stop means is engaged by the rim on the collar means.

14. The apparatus of claim **13** wherein the stop means is provided by projections from the outer surface of and around the longitudinal axis of the cyclone.

15. In a cleaning apparatus including an outer container comprising a bottom and a sidewall extending to and meeting the bottom, the sidewall having an interior surface, a dirty air inlet at an upper portion of the outer container spaced from the bottom which is oriented for supplying dirt laden air into the container tangentially to the interior surface of the outer container which has a circular cross-section and an air outlet from the container at the upper portion of the container; a circular cross-sectioned cyclone having a longitudinal axis and mounted inside the container, the cyclone comprising a cyclone air inlet at an upper end having a first diameter of the cyclone in air communication with the air outlet of the container, an interior dirt rotational surface of frusto-conical shape for receiving an air flow from the air inlet and for maintaining its velocity to a cone opening smaller in diameter than the diameter of the upper end of the cyclone, the air inlet being oriented for supplying air tangentially to the surface, an outer surface of frusto-conical shape, and a cyclone air outlet communicating with the interior of the cyclone adjacent the upper end of the cyclone; a dirt receiving and collecting chamber extending from the cone opening; and means for generating an air flow which passes sequentially through the dirty air inlet, the container, the cyclone air inlet, the cyclone, the receiving chamber and the cyclone air outlet, the air flow rotating around the frusto-conical interior surface of the cyclone and depositing the dirt in the receiving chamber the improvement which comprises:

a disc means provided on the outside of the cyclone intermediate the receiving chamber and the air outlet of the container and around to the longitudinal axis of the cyclone with a space between the interior surface of the container and the disc means for passage of air wherein the disc means retards long strands in the dirt from clogging the air outlet and retains the strands in the container.

16. The apparatus of claim **15** wherein the disc means is circular around the longitudinal axis of the cyclone.

17. The apparatus of claim **16** wherein the disc means is conical in shape around the longitudinal axis with a smaller opening attached to the outer surface of the cyclone and a larger opening below the smaller opening facing the bottom of the container such that there is a tapered wall between the openings.

18. The apparatus of claim **17** wherein the larger opening has a flange perpendicular to the longitudinal axis of the container between the larger opening of the disc means and the inside surface of the container.

* * * * *

EXHIBIT B

United States Patent [19]

Dyson

[11] **Patent Number: 4,853,008**

[45] **Date of Patent: Aug. 1, 1989**

[54] **COMBINED DISC AND SHROUD FOR DUAL CYCLONIC CLEANING APPARATUS**

[75] Inventor: **James Dyson**, Bathford, England

[73] Assignee: **Notetry Limited**, Bristol, England

[21] Appl. No.: **224,694**

[22] Filed: **Jul. 27, 1988**

[51] **Int. Cl.**[4] **B01D 45/12**

[52] **U.S. Cl.** **55/345**; 55/391; 55/395; 55/429; 55/459.1; 209/144

[58] **Field of Search** 55/345, 391, 394, 395, 55/410, 429, 459.1, 473; 209/144

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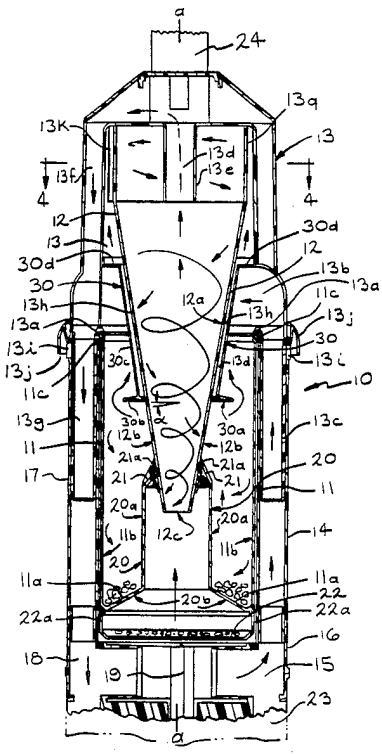
4,593,429	6/1986	Dyson	15/353
4,643,748	2/1987	Dyson	55/338
4,756,729	7/1988	Brunnmair et al.	55/391

Primary Examiner—Jay H. Woo
Assistant Examiner—C. Scott Bushey
Attorney, Agent, or Firm—Ian C. McLeod

[57] **ABSTRACT**

A combined disc and shroud unit (**30**) for use in a dual cyclonic cleaner (**10**) is described. The unit fits on the outside surface (**12***b*) of the cyclone (**12**) and aids in removal of dirt and fibrous particles in the container (**11**). Improved separation is achieved because of the unit.

28 Claims, 2 Drawing Sheets



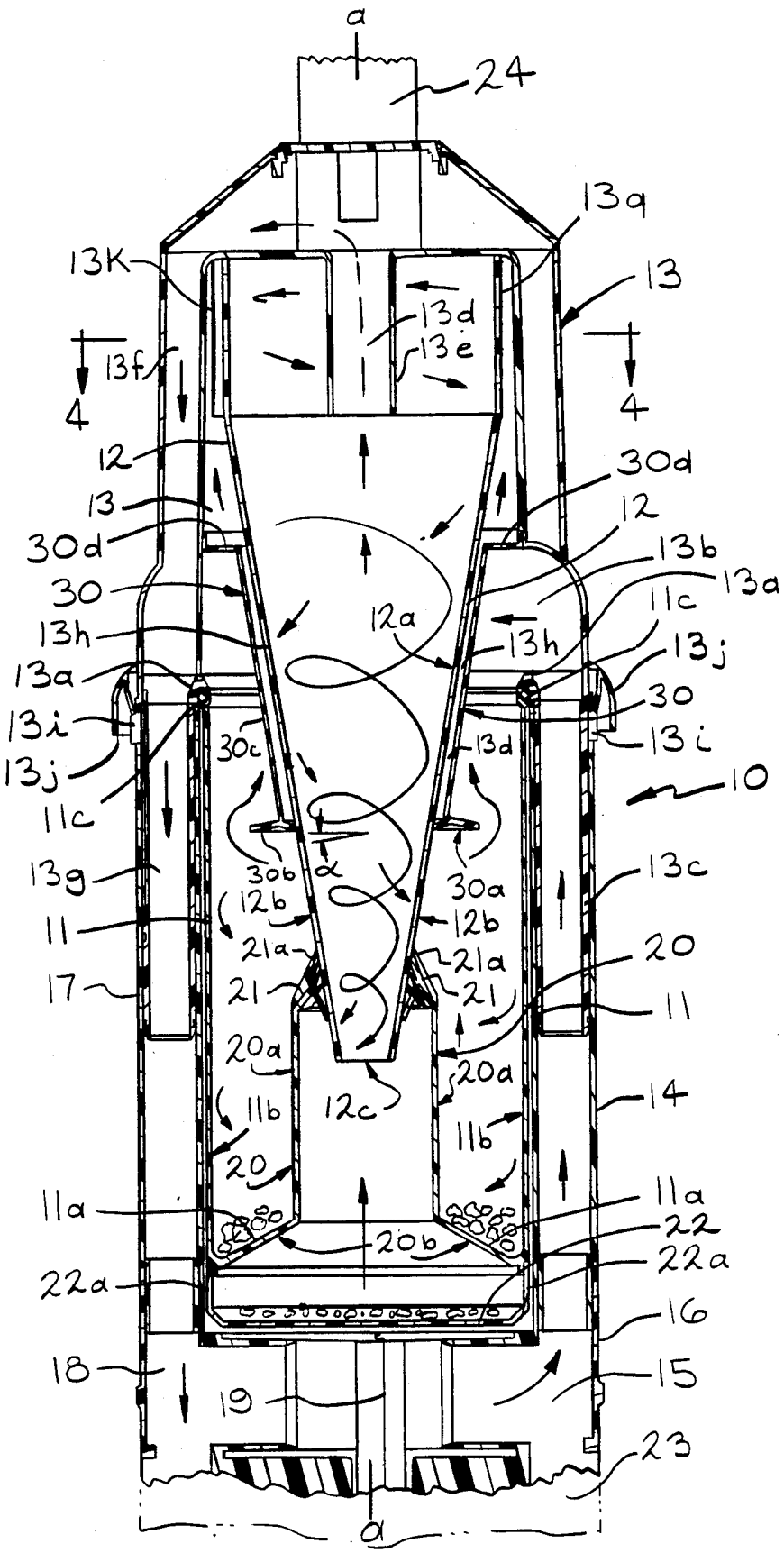

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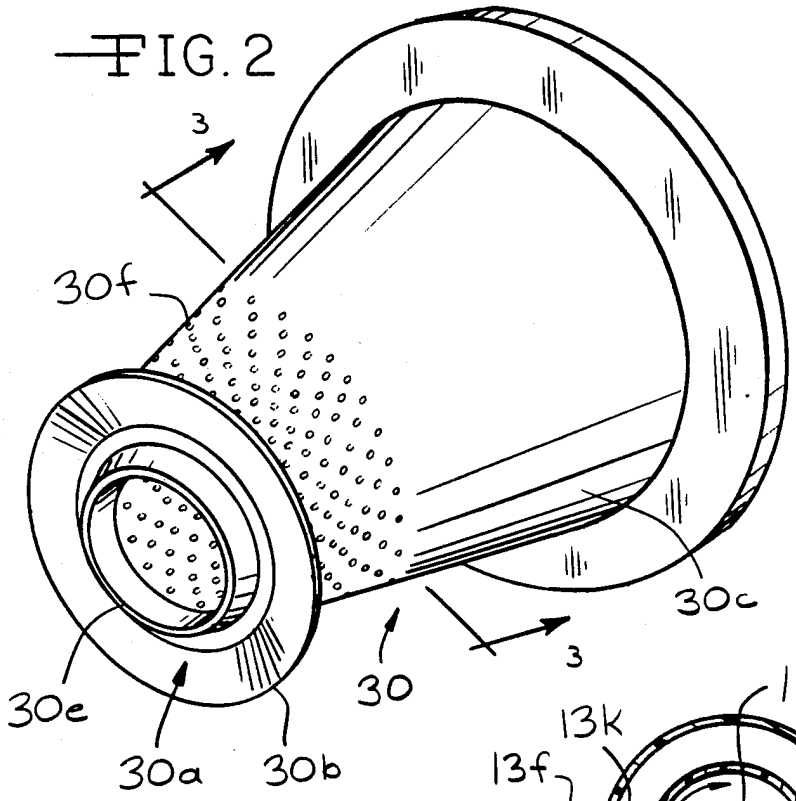
FIG. 1

FIG. 2



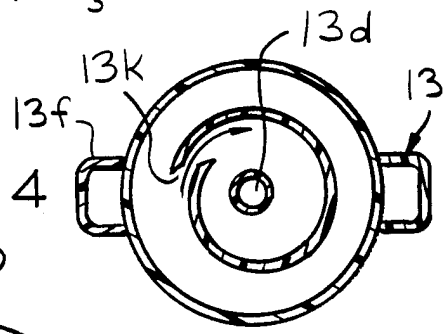


FIG. 4

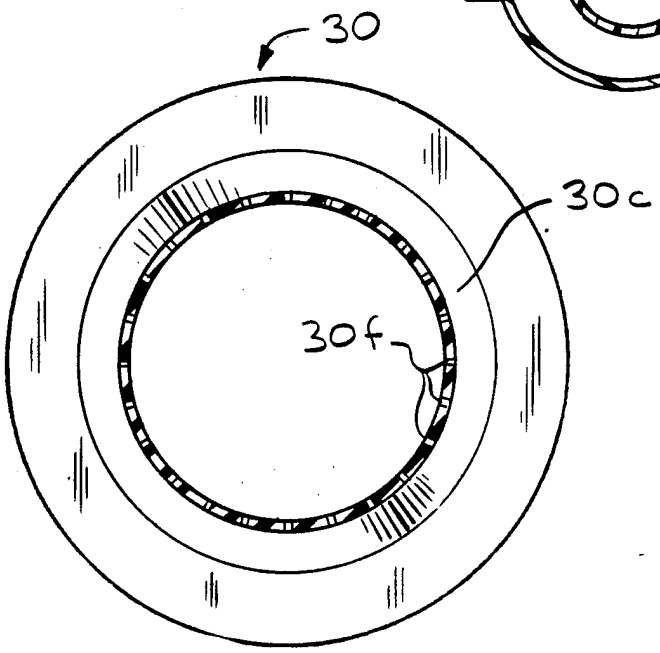


FIG. 3

COMBINED DISC AND SHROUD FOR DUAL CYCLONIC CLEANING APPARATUS

BACKGROUND OF THE INVENTION

(1) Field of the Invention

The present invention relates to a combined disc and shroud for a dual cyclonic cleaning apparatus. In particular the present invention relates to an apparatus which has an improved means for retaining dirt in an outer cyclonic container while allowing clean air to pass into a frusto-conically shaped inner cyclone.

(2) Prior Art

Cyclonic vacuum cleaning apparatus are shown in my U.S. Pat. Nos. 4,573,236, 4,593,429, 4,571,772 and 4,643,748. My U.S. Pat. No. 4,643,748 describes a dual cyclonic cleaning apparatus wherein a disc is mounted on the outside of a frusto-conically shaped inner cyclone in order to retain dirt in a first cyclonic cleaner. A separate shroud is provided for inlet of air into the second cyclone, including a moveable collar to dislodge accumulated dirt. A perforated inlet to the shroud has also been used on a cyclonic vacuum cleaner marketed in Japan in place of the collar. In these cleaners, the shroud and disc are separate from each other although both function to retain dirt particularly fibrous dirt in the container. The separate disc and shroud work well; however, there was a need for an improved design providing better separation of dirt in the outer cyclone than was achieved by the earlier apparatus.

It was found that by experimenting with the position of the holes and their location it was possible to reduce the blocking of the holes by fibrous particles.

OBJECTS

It is therefore an object of the present invention to provide an improved cleaning apparatus wherein the shroud and disc are combined together for mounting on the outside of the inner cyclone. Further, it is an object of the present invention to provide a combined disc and shroud which is simple and inexpensive to construct and easy to clean of fibrous matter, and which at the same time prevents escape from the outer cyclone of fibrous matter (or in the case of over-filling by the operator of all matter) and at the same time prevents or discourages the blocking of the holes by fibrous particles. These and other objects will become increasingly apparent to those skilled in the art and by reference to the drawings.

IN THE DRAWINGS

FIG. **1** is a front cross-sectional view of the preferred upright vacuum cleaning apparatus of the present invention, particularly showing the mounting of the combined shroud and disc on the outside of the inner cyclone.

FIG. **2** is a perspective view of the combined disc and shroud.

FIG. **3** is a cross-sectional view along line **3**—**3** of FIG. **2** showing the perforations **30***f*.

FIG. **4** is a cross-sectional view along line **5**—**5** of FIG. **1** showing the tangential entry into the inner cyclone **12**.

GENERAL DESCRIPTION

The present invention relates to a cleaning apparatus including an outer container comprising a bottom and a sidewall extending to and meeting the bottom, the sidewall having an interior surface, a dirty air inlet which is oriented for supplying dirt laden air into the container tangentially to the interior surface of the outer container which has a circular cross-section and an air outlet from the container; a circular cross-sectioned cyclone having a longitudinal axis mounted inside the container, the cyclone comprising a cyclone air inlet at an upper end having a first diameter of the cyclone in air communication with the air outlet of the container, an interior dirt rotational surface of frusto-conical shape for receiving an airflow from the air inlet and for maintaining its velocity to a cone opening smaller in diameter than the diameter of the upper end of the cyclone, the air inlet being oriented for supplying air tangentially to the surface, an outer surface of frusto-conical shape, and a cyclone air outlet communicating with the interior of the cyclone adjacent the upper end of the cyclone; a dirt receiving and collecting chamber extending from the cone opening; and means for generating an air flow which passes sequentially through the dirty air inlet, the container, the cyclone air inlet, the cyclone, the receiving chamber and the cyclone air outlet, the air flow rotating around the frusto-conical interior surface of the cyclone and depositing the dirt in the receiving chamber the improvement which comprises:

a shroud means mounted on and around outer surface of the cyclone and having opposed ends along the longitudinal axis and providing for outlet air from the container into the air inlet to the cyclone wherein the shroud means is mounted below the air inlet to the cyclone at one of the opposed ends of the shroud means and extends along (preferably substantially parallel to) the outer surface to a position intermediate to the cone opening and the air inlet, wherein the shroud means contacts the outer surface of the cyclone for closure (which does not necessarily have to seal to the outer cyclone) at the other of the ends, and wherein the shroud means has perforations adjacent to the intermediate position for the outlet of air; and

disc means provided on the shroud means at the position intermediate the cone opening and the air inlet to the cyclone and around the axis of the cyclone with a space between the interior surface of the container and the disc means for passage of air, wherein the disc means aids in dirt removal in the first container. The disc particularly holds fluff down in the container.

SPECIFIC DESCRIPTION

FIGS. **1** and **4** show a cleaning apparatus **10**, such as in an upright vacuum cleaner, including an outer cyclone or container **11** and an inner cyclone **12**. The container **11** and cyclone **12** are relatively long and slender along the longitudinal axis a—a. The outer container **11** has a bottom **11***a* and a cylindrical inner surface **11***b* which extends from the bottom **11***a*. The container **11** is removable from an air-flow directing head **13**. A flexible ring seal **13***a* engages the end surface **11***c* of the outer container **11**. The head **13** includes a dirty air inlet passage **13***b* connected to a pipe **13***c* projecting downward from the head **13** into an inlet pipe **14** connected to an air inlet chamber **15** in cleaner casing **16**. An outlet passage **13***d* is provided in the head **13** by conduit **13***e* leading to passage **13***f* connected to pipe **13***g* projecting into an outlet pipe **17** leading to air outlet chamber **18** in casing **16**. The air could vent at the top of the head **13** (not shown). There are o-ring seals **13***i* on the outside of pipes **13***c* and **13***g*, respectively, sealing

with pipes **14** and **17**, respectively. Motor pan **19** draws air from cleaner head **23** and blows it to chamber **15**. The cleaner head **23** can pivot on the cleaner **10** and can also have a brush (not shown). A handle **24** is provided for moving the upright cleaner **10**.

The cyclone **12** has a frusto-conical shape and an inner wall **12***a* leading to a cone opening **12***c* and an outer wall **12***b*. A portion of the cyclone **12** and the cone opening **12***c* projects into a receiving and collecting chamber **20** for collecting dirt from cyclone **12**. The outer wall **12***b* of the inner cyclone **12** engages a tapered ring seal **21** mounted on one end of an elongated cylindrical portion **20***a* of the receiving chamber **15**. The tapered seal **21** includes at least one concentric ring **21***a* which engage the outer wall **12***b* of the cyclone **12**. The receiving chamber **20** is preferably integrally joined with a frusto-conical or outwardly tapered portion **20***b* which also serves as the bottom **11***a* of the container **11**. A removable dish shaped member **22** covers the end of the tapered portion **15***b*. The sidewalls **22***a* are cylindrical.

A combined integral shroud and disc unit **30** is mounted intermediate the inlet **13***k* to the cyclone **12** and the cone opening **12***c* as particularly shown in FIG. **1**. The unit **30** provides an outlet passage **13***h* from the container **11**. The unit **30** includes a disc **30***a* which is preferably conically shaped with a larger downwardly tapered portion **30***b*, facing the bottom **11***a* of the container **11**. The unit **30** is tapered with walls **30***c* preferably parallel to the outside **12***b* of the cyclone **12**. The walls **30***c* end in a flange **30***d* which surrounds and encloses the inlet passage **13***k* to the inner cyclone **12**. A lower portion **30***e* contacts the outside **12***b* of the cyclone **12** adjacent the disc **30***b*. Perforations **30***f* are provided around the wall **30***c* on about a lower one-third of the wall **30***c* adjacent the disc **30***b*. The disc preferably has a downwardly inclined angle alpha between about 97½ to 110° from the axis area or 7½ to 20° from a line perpendicular to the axis.

In operation, the fan unit **19** blows air into inlet chamber **15** through tube **14** into inlet **13***b* of the container **11**. The air swirls down around the inner wall **11***b* of the container **11** and up along the outside of cylindrical portion **20***a* of receiver **20**, moves along outer wall **12***b*, over disc **30***b*, through perforations **30***f* and up through passage **13***h* defined by shroud unit **30** and wall **12***b*. The air then moves into inlet passage **13***k* of had **13** and into the inner cyclone **12** wherein it moves around inner wall **12***a* and to cone opening **12***c* and then moves upward to outlet **13***d* in passage **13***e* and then exhausts to atmosphere or through tube **17** and chamber **18** to motor fan. The dirt collects on the bottom **11***a* of the container **11** and in the dish shaped member **22** as shown. Finer dirt collects primarily in the dish shaped member **22**. The inlet chamber **15** is preferably connected to the cleaning head **23**.

It has been found that having the perforations **30***f* immediately adjacent the disc **30***b* provides an advantage in separation. In the prior designs of U.S. Pat. No. 4,571,772, the shroud was remote from the disc, and thus allowed a greater chance of dirt escaping into the inner cyclone **12** and helps clogging of the holes by fibrous particles. Preferably the cross-sectional area of the perforations **30***f* exceeds the cross-sectional area of either the inlet passage **13***b* or outlet passage **13***k*.

It is intended that the foregoing description be only illustrative and that the present invention be limited only by the hereinafter appended claims.

I claim:

1. In a cleaning apparatus including an outer container comprising a bottom and a sidewall extending to and meeting the bottom, the sidewall having an interior surface, a dirty air inlet which is oriented for supplying dirt laden air into the container tangentially to the interior surface of the outer container which has a circular cross-section and an air outlet from the container; a circular cross-sectioned cyclone having a longitudinal axis mounted inside the container, the cyclone comprising a cyclone air inlet at an upper end having a first diameter of the cyclone in air communication with the air outlet of the container, an interior dirt rotational surface of frusto-conical shape for receiving an air flow from the air inlet and for maintaining its velocity to a cone opening smaller in diameter than the diameter of the upper end of the cyclone, the air inlet being oriented for supplying air tangentially to the surface, an outer surface of frusto-conical shape, and a cyclone air outlet communicating with the interior of the cyclone adjacent the upper end of the cyclone; a dirt receiving and collecting chamber extending from the cone opening; and means for generating an air flow which passes sequentially through the dirty air inlet, the container, the cyclone air inlet, the cyclone, the receiving chamber and the cyclone air outlet, the air flow rotating around the frusto-conical interior surface of the cyclone and depositing the dirt in the receiving chamber the improvement which comprises:

(a) a shroud means mounted on and around the outer surface of the cyclone and having opposed ends along the longitudinal axis and providing for outlet air from the container into the air inlet to the cyclone wherein the shroud means is mounted at one end below the air inlet to the cyclone and extends along the outer surface with the other end at a position intermediate to the cone opening and the air inlet to the cyclone, wherein the shroud means contacts the outer surface of the cyclone for closure at the other of the ends and wherein the shroud means has perforations adjacent to the position intermediate to the cone opening for the flow of air from the outer container to the cyclone inlet; and

(b) disc means provided on the shroud means at a lower longitudinal extent of the shroud means and the air inlet of the cyclone and around the axis of the cyclone with a space between the interior surface of the container and the disc means for passage of air, wherein the disc means aids in dirt removal in the first container by preventing some of the dirt from flowing into the air inlet to the cyclone.

2. The apparatus of claim **1** wherein the disc means is circular in cross-section around the longitudinal axis of the cyclone.

3. The apparatus of claim **1** wherein the disc means has a conical shape around the shroud means such that a larger portion of the conical shape faces towards the bottom of the container.

4. The apparatus of claim **3** wherein the conical shape when viewed as a cross-section of the shroud means and disc means through the longitudinal axis is at a downwardly inclined angle of about 7½ to, 20° from a line perpendicular to the longitudinal axis of the cyclone.

5. The apparatus of claim **1** wherein the perforations in the shroud means are circular and are provided around the circumferential extent of the shroud means

and cover about one-third of the shroud means above the disc means.

6. The apparatus of claim **1** wherein the shroud means has a flange around the longitudinal axis at the end adjacent the air inlet to the cyclone which is in close relationship to the outside of the cyclone so as to provide a chamber providing the inlet to the cyclone.

7. The apparatus of claim **1** wherein the disc means is positioned about one-third of the distance between the cone opening and the air inlet of the cyclone.

8. The apparatus of claim **1** wherein the dirt receiving and collecting chamber is mounted on the outer surface of the cyclone and has a conical portion adjacent the bottom of the container which tapers outward towards the sidewall and the bottom of the container.

9. The apparatus of claim **8** wherein the chamber has a cylindrical portion which extends from the outer surface of the cyclone to the conical portion which tapers outward from the cylindrical portion towards the sidewall and the bottom of the container.

10. The apparatus of claim **9** wherein the cylindrical portion has a diameter smaller than a diameter of the disc means.

11. The apparatus of claim **1** wherein the outer container has a substantially cylindrical sidewall.

12. The apparatus of claim **11** wherein the apparatus is a vacuum cleaner for household use, wherein the inlet to the container and the outlet from the cyclone include separate tubes mounted parallel to the axis adjacent the opposite sides of the container leading to the inlet and from the outlet and wherein the means for generating an air flow is mounted in a casing with a cleaning means which contacts a surface to be cleaned, wherein the means for generating an air flow draws air into the inlet to the container through one of the tubes and out the outlet from the cyclone through the other of the tubes to and through the casing.

13. The apparatus of claim **12** wherein the disc means is circular in cross-section around the longitudinal axis of the cyclone.

14. The apparatus of claim **12** wherein the disc means has a conical shape around the shroud means such that a larger portion of the conical slope faces towards the bottom of the container.

15. The apparatus of claim **14** wherein the conical shape when viewed in a cross-section of the shroud means and disc means through the longitudinal axis is at an angle of about 7½ and 20° to a line perpendicular to the longitudinal axis of the cyclone.

16. The apparatus of claim **12** wherein the perforations are circular and are provided around the circumferential extent of the shroud means and cover about one-third of the shroud means above the disc means.

17. The apparatus of claim **12** wherein the shroud means has a flange around the longitudinal axis at the end adjacent the inlet to the cyclone which is in close spaced relationship to the outside of the cyclone.

18. The apparatus of claim **12** wherein the disc means is positioned about one-third of the distance between the cone opening and the air inlet of the cyclone.

19. The apparatus of claim **12** wherein the dirt receiving and collecting chamber is mounted on the outer surface of the cyclone and has a conical portion adjacent the bottom of the container which tapers outward towards the sidewall and the bottom of the container.

20. The apparatus of claim **19** wherein the chamber has a cylindrical portion which extends from the outer surface of the cyclone to the conical portion which tapers outward from the cylindrical portion towards the sidewall and the bottom of the container.

21. The apparatus of claim **20** wherein the cylindrical portion has a diameter smaller than a diameter of the disc means.

22. The apparatus of claim **1** wherein the total cross-sectional area of all the perforations exceeds the cross-sectional area of each of the air inlet and the air outlet from the cyclone.

23. A shroud means for use in a cleaning apparatus including an outer container comprising a bottom and a sidewall extending to and meeting the bottom, the sidewall having an interior surface, a dirty air inlet which is oriented for supplying dirt laden air into the container tangentially to the interior surface of the outer container which has a circular cross-section and an air outlet from the container; a circular cross-sectioned cyclone having a longitudinal axis mounted inside the container, the cyclone comprising a cyclone air inlet at an upper end having a first diameter of the cyclone in air communication with the air outlet of the container, an interior dirt rotational surface of frusto-conical shape for receiving an air flow from the air inlet and for maintaining its velocity to a cone opening smaller in diameter than the diameter of the upper end of the cyclone, the air inlet being oriented for supplying air tangentially to the surface, an outer surface of frusto-conical shape, and a cyclone air outlet communicating with the interior of the cyclone adjacent the upper end of the cyclone; a dirt receiving and collecting chamber extending from the cone opening; and means for generating an air flow which passes sequentially through the dirty air inlet, the container, the cyclone air inlet, the cyclone, the receiving chamber and the cyclone air outlet, the air flow rotating around the frusto-conical interior surface of the cyclone and depositing the dirt in the receiving chamber the improvement which comprises:

(a) a shroud means to be mounted on and around the outer surface of the cyclone and having opposed ends along the longitudinal axis and providing for outlet air from the container into the air inlet to the cyclone wherein the shroud means is mounted at one end below the air inlet to the cyclone at one of the opposed ends of the shroud means and extends along the outer surface with the other end at a position intermediate to the cone opening and the air inlet to the cyclone, wherein the shroud means contacts the outer surface of the cyclone for closure at the other of the ends and wherein the shroud means has perforations adjacent to the position intermediate to the cone opening for the flow of air from the outer container to the cyclone inlet; and

(b) disc means provided on the shroud means at a lower longitudinal extent of the shroud means and the air inlet of the cyclone and around the axis of the cyclone with a space between the interior surface of the container and the disc means for passage of air, wherein the disc means aids in dirt removal in the first container by preventing some of the dirt from flowing into the air inlet to the cyclone.

24. The shroud means of claim **23** wherein the disc means is circular in cross-section around the longitudinal axis of the cyclone.

25. The shroud means of claim **23** wherein the disc means has a conical shape around the shroud means such that a larger portion of the conical shape faces towards the bottom of the container.

26. The shroud means of claim **25** wherein the conical shape when viewed as cross-section of the shroud means and disc means through the longitudinal axis is at a downwardly inclined angle of about 7½ to 20° from a line perpendicular to the longitudinal axis of the cyclone.

27. The shroud means of claim **23** wherein the perforations in the shroud means are circular and are provided around the circumferential extent of the shroud means and cover about one-third of the shroud means above the disc means.

28. The shroud means of claim **1** wherein the shroud means has a flange around the longitudinal axis at the end adjacent the air inlet to the cyclone which is in close relationship to the outside of the cyclone so as to provide a chamber providing the inlet to the cyclone.

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EXHIBIT C

SULLIVAN & CROMWELL LLP

TELEPHONE: 1-212-558-4000
FACSIMILE: 1-212-558-3588
WWW.SULLCROM.COM

125 Broad Street
New York, NY 10004-2498

LOS ANGELES • PALO ALTO • WASHINGTON, D.C.
FRANKFURT • LONDON • PARIS
BEIJING • HONG KONG • TOKYO
MELBOURNE • SYDNEY

October 18, 2006

Via Facsimile and First-Class Mail

Ray L. Weber
Renner, Kenner, Greive, Bobak, Taylor & Weber
400 First National Tower
Akron, Ohio 44308

Re: Dyson, Inc. v. Maytag Corporation

Dear Ray:

I write concerning Maytag's Response to Interrogatory 18, served on October 12, 2006. In its Response, Maytag identified several patent claim elements of Claim 14 of U.S. Patent No. 4,826,515 (the '515 patent) that, in light of the Court's claim construction order, it contends were not present in the Hoover Fusion vacuum cleaners sold by it in the United States prior to Maytag's removal of the flange from the Fusion's cyclonic apparatus, including that "[t]he Hoover Fusion vacuum cleaner does not contain limitation (e) of the claim, which the Court has construed as 'a motor driven fan unit positioned vertically above and immediately adjacent to the cyclone outlet port.'" Maytag's Response also contends that, for the same reasons, this patent claim limitation also is absent from Claim 15 of U.S. Patent No. 4,643,748 (the '748 patent) and from Claims 1 and 23 of U.S. Patent No. 4,853,008 (the '008 patent).

Maytag's Response — insofar as it relates to the '748 and '008 patents — is improper because the parties expressly agreed that the Court's construction of the term "means for generating an airflow" applied only to Claim 14 of the '515 patent. This was made clear in the Joint Claims Construction Charts submitted to the Court (indicating that Term 10 applied only to Claim 14 of the '515 patent) and in the parties' claim construction briefs (*see, e.g.,* Maytag's Opening Br. at 17 ("All of the embodiments of a 'means for generating an airflow' presented in the '515 patent include a motor driven fan unit positioned vertically above and immediately adjacent the cyclone outlet port")). In fact, in Dyson's response to Maytag's opening claim construction brief, at p.9, Dyson expressly pointed out that "Maytag does not claim that [the other patents-in-suit] require that the motor driven fan unit be positioned vertically above and immediately adjacent to the cyclone outlet port. Indeed, the motor driven fan unit is shown below the container in

the drawings of the preferred embodiment of the '008 patent. *See* '008 patent, Fig. 1, element 19 (JA23)." Maytag never took issue with this statement.

For the above reasons, we request that Maytag revise its response to remove the contention that the '748 and '008 patents were not infringed by Maytag because the Court's construction of the term "means for generating an airflow" applies to the claims of those patents.

Sincerely,

Keith McKenna

cc: Francis DiGiovanni
(Connolly Bove Lodge & Hutz LLP)

Stephen P. Durchslag
(Winston & Strawn LLP)

Steven F. Reich
(Manatt, Phelps & Phillips, LLP)

C. Barr Flinn
(Young Conaway Stargatt & Taylor, LLP)

EXHIBITS D AND E

REDACTED IN THEIR ENTIRETY